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Cover

The Rollout—An eagle's eye view of the Space Shuttle Columbia just after it was moved from the Vehicle Assembly Building at the Kennedy Space Center on December 29. The Shuttle's 3½ mile journey to Pad 39A of the launch complex took approximately eight hours to complete aboard the massive crawler vehicle; it moved the 75-ton spacecraft at a rate of about ½ mile per hour.

Correction—The photo caption for the illustration shown on page 16 of the January 1981 issue of NASA Activities was incorrect. The photo did not depict a slide wire safety device; instead, shown in the foreground was a stainless steel cable that helps provide a good electrical path to the ground from atop the lightning mast mounted on the Fixed Service Structure.

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Shuttle Rollout Dec. 29

The Space Shuttle Columbia, the first destined to fly in space, was moved from the Vehicle Assembly Building to Launch Pad A at Complex 39, at Kennedy Space Center, Fla., on Dec. 29.

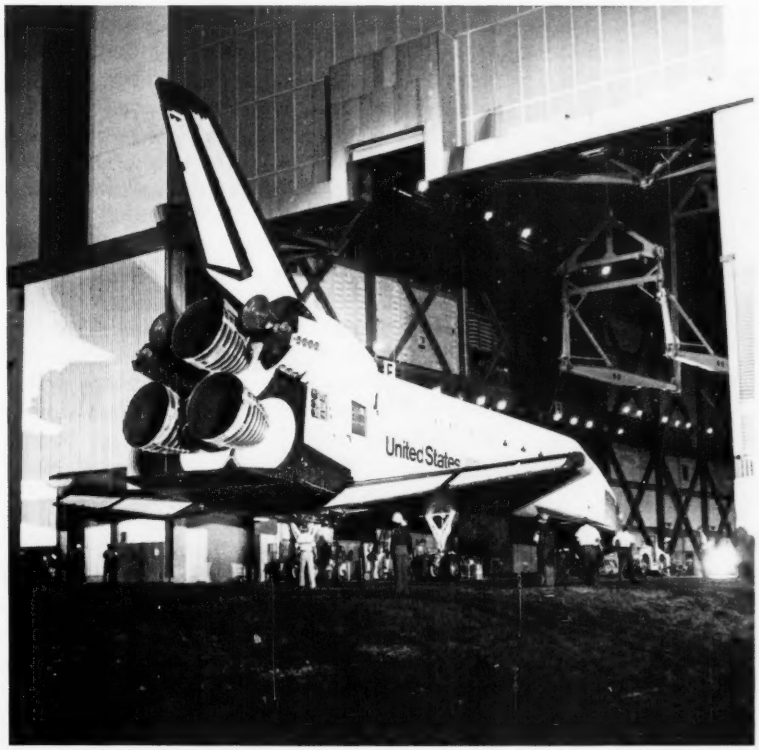
Rollout began at 8:00 a.m.; the Mobile Launcher Platform was harddown on the pedestals at the pad at 8:01 p.m. after portions of a small steel access tower on the pad which provides egress from the second level of the platform were removed.

Once in position, the Orbiter Access Arm was extended and crew module hatch opened. The Rotating Service Structure was moved into place around the vehicle on December 30.

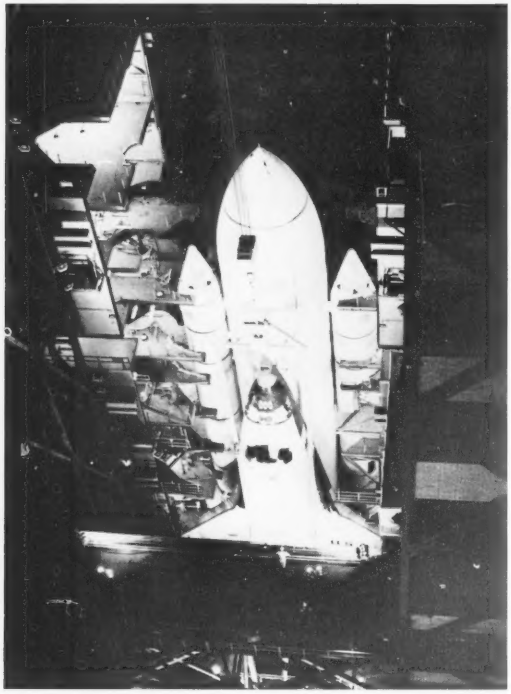
Activity at the pad next will be centered around the Shuttle Launch Pad Validation, a major test to verify connections between the Mobile Launcher Platform and ground systems at the pad. All interfaces between the Platform and the pad to supply power, propellants, gas, communications and water to the Shuttle are being made. Also, sophisticated Launch Processing System equipment in the Launch Control Center is being hooked up to the STS-1 vehicle so that power can be applied and tests can be conducted. A series of extensive tests will be performed to verify the Mobile Launch Platform is properly mated to the pad. Instrumentation onboard the Shuttle flight elements—the orbiter, external tank and twin solid rocket boosters—also will be checked to verify that test data can be received back at the Launch Control Center.

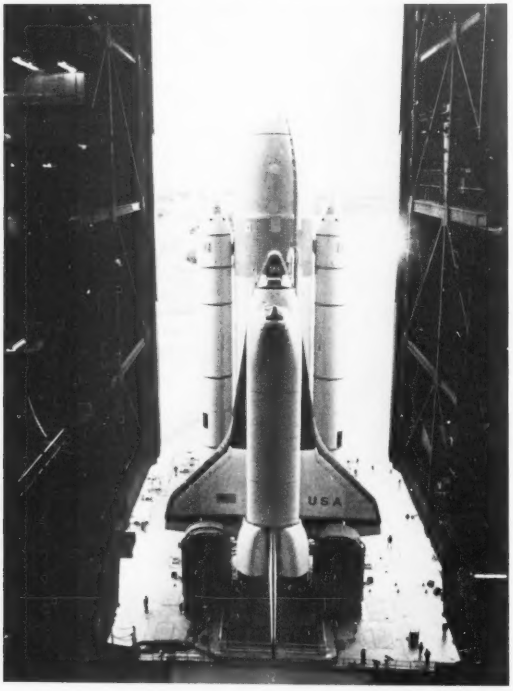
The next major test after the Shuttle Launch Pad Validation was the "Plugs Out Overall Test." During this test, all pad ground support equipment was disconnected to verify that all Shuttle systems can operate on internal power after liftoff.

The STS-1 vehicle was then powered up to support retesting of four Multiplexer/Demultiplexers and the Input/Output Processors. These parts of the orbiter's complex avionics system were removed prior to rollout to enhance their reliability and will be reinstalled before power is applied to the vehicle.



Final Steps to Launch—The Space Shuttle was moved the 300 yards from the Orbiter Processing Facility to the Vehicle Assembly Building Nov. 24. The move began at 6:01 p.m. and was completed approximately 30 minutes later. The Columbia is shown at top left, page 4, with external tank and solid rocket boosters stacked and mated in the Vehicle Assembly Building. The Columbia aboard the massive crawler vehicle (bottom left page 4) begins rollout to Launch Pad 39A on Dec. 29. The 3½ mile move from the Vehicle Assembly Building to the pad took approximately 8 hours.





Nimbus-6 Tracks Rowboat to Australia

A British mariner has left the West Coast in a rowboat bound for Australia carrying a space agency locater beacon. Peter Bird, a 33-year-old London photographer, left Baja California on Nov. 11, bound for Brisbane, Australia, which he expects to reach in about 9 to 12 months.

He is rowing the Britannia II, an 11-meter craft designed by Uffa Fox for Royal Navy rescue missions. Self-bailing and self-righting, Britannia brought Bird and another Briton, Derek King, across the Atlantic in 1974. This time, Bird is going it alone.

The beacon is the same type used on various data collection platforms on lakes, drifting buoys and other remote locations to measure, with the spacecraft Nimbus 6, such factors as water level, or to track ocean currents.

The Nimbus spacecraft was launched in June 1975. One of its nine advanced weather and environmental monitoring instruments acquires data from about 130 buoys, icebergs and other platforms around the world.

Britannia is carrying the same type transmitter used with Nimbus 6 to track an Atlantic two-man balloon crossing, an Egyptian desert expedition and a Japanese explorer's trek from Canada to the North Pole and down the length of Greenland, all in 1978. The beacon data for all these activities were transmitted to NASA's Goddard Space Flight Center, Greenbelt, Md., computed and returned to users as pinpoint locations.

Bird's first attempt at the Pacific crossing left San Francisco through the Bay, Oct. 1. Britannia's hatches were not square; thus, capsizing in rough waves, she shipped some water which damaged supplies and caused a list. The single sideband radio antenna went overboard, cutting communication with shore. Bird pulled into Baja, refitted the hatches and picked up a new antenna.

Bird expects to communicate, via radio, with his San Francisco shore station on the first and 15th of each month. He will use the Nimbus location data to correct his own position computations.

Bird's next critical event occurs at 483 kilometers from America's West Coast. This is the point of no return, where, because of prevailing winds and currents, it will be impossible to row the boat back to shore.

Britannia's Nimbus transmitter puts out a burst each minute which identifies the platform, but

Nimbus, in its polar orbit, only "sees" the boat during about six of its orbits each day. To "stretch" its life, the veteran spacecraft has its tape recorder turned off for all but about one of these orbits (its main tape recorder failed soon after launch, and it has operated ever since on the back-up).

Meanwhile, Bird's data goes up to Nimbus, down to a ground station in Fairbanks, Alaska, and thence to Goddard. There it is computer processed and mailed to Bird's shore station in San Francisco. During stress times, the station can call in to Goddard for positions. At Goddard, Britannia data is processed by Keith Long; Gene Gilbert is Nimbus random access measurement system user coordinator.

Lightweight Tank Work Underway

Assembly of the Space Shuttle's first lightweight external propellant tank has begun at the Marshall Space Flight Center's Michoud Assembly Facility in New Orleans, La. Work began with the precision trimming and welding of aluminum gore segments to form the aft dome of the liquid hydrogen tank. The first lightweight tank is expected to be completed and ready for delivery in the summer of 1982, in time to support the Space Shuttle's fifth launch.

The modified tank will be 6,000 pounds lighter than its predecessor, and will therefore increase the Shuttle's payload-carrying capability by about the same amount. To accomplish this weight reduction, the external tank has been redesigned to incorporate the results of a recently completed structural test program. The program showed that it is possible to reduce the thickness of many of the aluminum skin panels without affecting the integrity of the tank.

Changes to the materials used in certain components have also been made to take advantage of recent developments in the metals field. And, the antigeyser line, used in the liquid oxygen fill system, is also being deleted. The feasibility of its removal will be verified during tests of the Shuttle's main propulsion system at the National Space Technology Laboratories near Bay St. Louis, Miss.

The external tank—actually two tanks connected by a collar-like intertank—carries the liquid hydrogen and liquid oxygen propellants for the Shuttle's three main engines. It is the only major element of the Shuttle that is not recovered for reuse. The external tank is being built by Martin Marietta Aerospace, Denver Division, under contract to the Marshall Center.

Sun-Powered Laser Demonstrated at NASA Center

The world's first gas laser powered directly by sunlight has been demonstrated by two researchers at the Langley Research Center, Hampton, Va.

Researchers Ja H. Lee and Willard R. Weaver directed the light output from a solar simulator onto a quartz tube filled with a gaseous iodide. The light excited the iodide, causing lasing and the emission of a 5-watt burst of concentrated light waves.

The directly Sun-powered laser would eliminate the need in current laser systems for intermediate energy conversion to achieve lasing. This eliminates the energy conversion components and reduces the system's size, weight, complexity and cost.

NASA's interest in lasers includes such applications as remote sensing of the Earth and its environment, optical data processing and transfer and power transmission for space operations.

In one concept, a space-based solar-powered laser system radiates a laser beam to remote space operations. At the operations site, the laser beam can be transformed to conventional energy forms such as electricity or heat. The laser beam could also be converted to propulsive energy in a specially designed space engine which would provide economical orbital transfer of payloads.

NASA Deputy Administrator Resigns

Dr. Alan M. Lovelace, Deputy Administrator of NASA, submitted his resignation effective Dec. 29 and agreed to accept an appointment as Associate Administrator/General Manager.

Lovelace was appointed Deputy Administrator by President Ford in June 1976. He had previously been Associate Administrator for the Office of Aeronautics and Space Technology since September 1974.

Earlier, Dr. Robert A. Frosch, NASA Administrator, an appointee of President Carter, submitted his resignation effective Jan. 20, 1981.

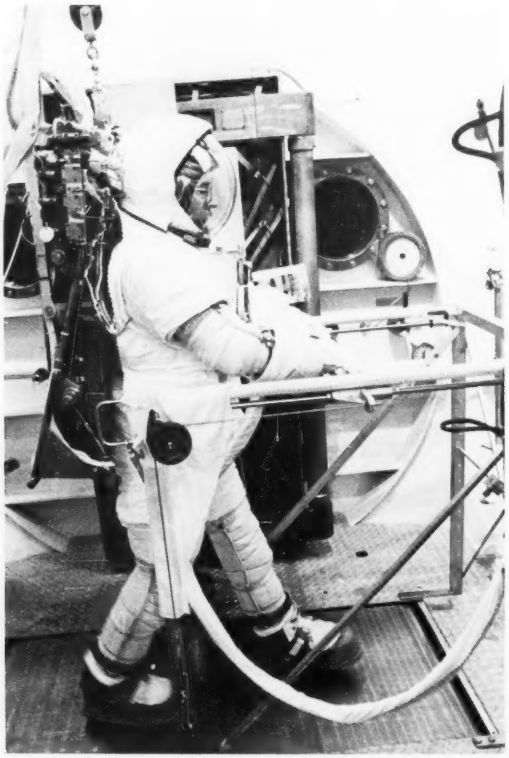
As Associate Administrator/General Manager, Lovelace will perform the basic management duties that he has been performing as Deputy Administrator and will serve as Acting Administrator during the absence of Frosch until a new Administrator has been named by the President and confirmed by the Senate.

The resignation and appointment as Associate Administrator/General Manager was discussed with both President Carter's and then President-elect

Reagan's staffs and they agreed to the arrangement to provide maximum continuity of management of NASA.

From 1954 to 1956 Lovelace served in the U.S. Air Force, after which he continued to work as a civilian at the Air Force Materials Laboratory, Wright-Patterson Air Force Base, Dayton, Ohio, where he was named Chief Scientist in January 1964 and Director in 1967.

In October 1972, Lovelace was named Director of Science and Technology, Air Force Systems Command, Andrews Air Force Base, Md. He went on to become principal Deputy to the Assistant Secretary of the Air Force for Research and Development, a post he held until joining NASA.



Space Walk Simulation—Space Shuttle Columbia commander John Young is shown here during part of a 10 hour evaluation test of the Space Shuttle extravehicular activity pressure suit. The test required the astronaut to perform tasks equivalent to those on a space walk to determine if the suit's life support system and cooling system meet specification.

Fire Resistant Material for Aircraft

A spongy, light-weight material that resists ignition better than any materials now in use, and upon ignition at 426 degrees Celsius only chars and decomposes, has been developed for NASA's Johnson Space Center in Houston by the Solar Division of International Harvester, San Diego.

The new flame-resistant material, named "polyimide resilient foam," could further reduce inflight fire risks and lengthen the time allowed for airline passenger evacuation from two to five minutes for a survivable crash complicated by an external fuel fire.

Accident statistics given the U.S. House of Representatives, 96th Congress, in 1979 revealed that from 1965 through 1978 fires occurred in about 20 percent of all air carrier accidents involving passenger operations.

During this period there were 2,727 fatalities, 469 or 17 percent attributed to the effects of fire or smoke. The data were presented in hearings before the Subcommittee on Oversight and Review of the Committee on Public Works and Transportation.

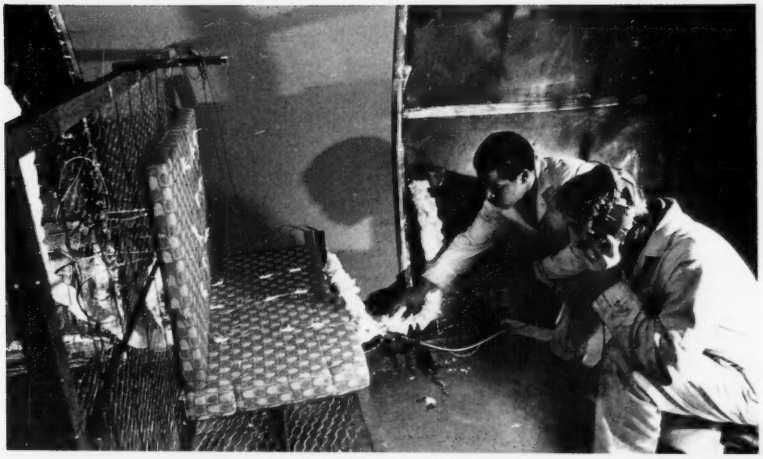
Once in production, polyimide foam also could provide extra safety for surface transportation including school buses, trains and automobiles, NASA fire experts said.

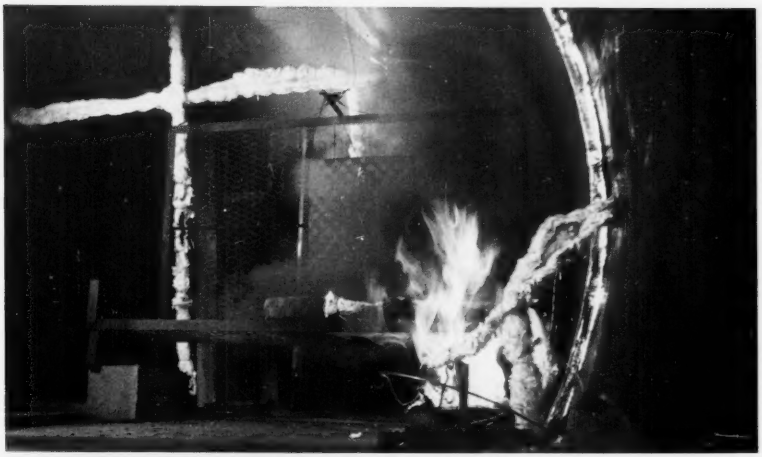
Polyimide foam is being suggested as a replacement for polyurethane used in aircraft seat cushions, which represent the largest amount of flammable material in airline interiors. Since the new polyimide does not outgas until it begins to char at the approximate 426 degree C temperature, it is also safer from toxic fumes produced by polyurethane at ignition.

As part of a cooperative NASA/Federal Aviation Administration program to enhance occupant safety in post-crash fires, four polyimide double seats will be supplied for test and evaluation by the FAA in a C-133 aircraft at the FAA's Technical Center in Atlantic City, N.J. The C-133 is a surplus military cargo aircraft modified to resemble typical large jet transports. The test aircraft will be subjected to a test fire representative of post-crash fires.

The foam is not only safer, say NASA fire safety experts, but also provides an estimated 50 percent weight savings, thereby improving aircraft energy efficiency.

By varying the ingredients of polyimide, the material hardens and can be used as light-weight wallboard or high-strength rigid floor panels while retaining its fire resistance. As a thermal-acoustical





Photos of vacuum chamber test from the polyimide resilient foam to test its fire resistance. From top left, shown are scenes before, during, and after the test. The first lasted 15 minutes and was fueled by jet fuel beneath the seat, burning at a constant temperature of 1800 degrees Fahrenheit. As shown in the bottom photo, there was little damage; the charred area was held to the area where the flame was contained.

insulation with polyimide foam, wallboard could act as thermal or fire barriers, reducing the cabin interior heat load and preventing other flammable materials from igniting.

Manufacturers of commercial aircraft and airline companies have sought improved fire-resistant materials since the early 1960s. By the late 1960s NASA had developed some fire-resistant materials for the Apollo spacecraft and Skylab vehicle.

The Technology Utilization Office at NASA Headquarters recommended these materials be made available to the public, particularly the aircraft industry, which chose not to adopt them because the materials lacked durability, were not commercially available, and cost too much to produce. Further efforts resulted in development of polyimide resilient foam, produced for NASA by the Solar Division of International Harvester. Limited production is to begin next year.

Shuttle Main Engine Completes Flight Certification Test

NASA's fourth and final cycle of certification tests of the Space Shuttle Main Engine first flight configuration was completed Dec. 2 at the National Space Technology Laboratories, Bay St. Louis, Miss.

The fourth cycle was concluded with a 10-second static firing of engine number 0009. This final series included 13 test firings of the engine for a total of 5,040 seconds. Most of the tests were run for 520 seconds (the burn time required for a typical Shuttle mission) at 102 percent of the engine's rated power level. However, during one test the engine was operated at 104 percent to demonstrate design margin; and in two others it was fired for 665 and 823 seconds to simulate the longer firing times required for aborted missions.

The Space Shuttle Main Engine Flight Certification program required completion of four sets of test cycles (each cycle consisting of 13 tests and over 5,000 seconds of operation) using two different engine assemblies. All of the test cycles were essentially identical except the fourth which raised the power level verification from 100 to 102 percent of rated power.

Rockwell International's Rocketdyne Div., Canoga Park, Calif., developer of the engine, is responsible for conducting the tests for NASA's Marshall Space Flight Center, Huntsville, Ala.

Outsized Lightning Rod—A new structure in the skyline of the Kennedy Space Center launch complex in an 80-foot tall fiberglass lightning mast. The tower functions as an electrical insulator to protect the Mixed Service Structure and surrounding pad equipment from strokes of lightning; it was installed at Launch Complex 39's Pad B, takeoff point for the Space Shuttle in the mid-1980s.

Listening to Saturn

As the NASA/JPL Voyager 1 spacecraft sped toward its November 12 closest approach to Saturn, a pair of 10-meter long rabbit ears dangled from its body, trolling for sounds. Those sounds, returned to Earth, will enable a team of scientists who learn by listening to form a clearer idea of the makeup of the environment around the ringed planet.

Dr. Fred Scarf, a senior scientist at TRW Defense and Space Systems Group, heads the team. He is the principal investigator for Voyager's plasma wave instrument. He and his co-investigators at the University of Iowa, where the rabbit-ear device was built were hearing bursts of very intense, low-frequency radio signals produced by charged-particle activity in the vicinity of Saturn. They had expected

a smoother stream of signals, and they are at work now trying to figure out what these signal bursts indicate about the nature of Saturn.

The device which brings home these sounds of Saturn is a simple one. The rabbit ears—shared with Voyager's radio astronomy experiment—serve as antennas to pull in the signals emitted by Saturn's plasma particles and their interactions. An audio amplifier about the size of a loose-leaf notebook sends the signals into Voyager's main radio system for transmission to Earth, where the Deep Space Network receivers relay them to NASA's Jet Propulsion Laboratory.

Scarf and his colleagues analyze these signals and attempt to see behavior patterns in the abundance of charged-particle activity that goes on constantly at Saturn. As patterns emerge, they and other planetary scientists can improve on the overall picture they have of Saturn, the farthest planet in our solar system to be explored.

As the sounds are analyzed, plasma wave investigators, working with other Voyager experiments and their data, will begin to answer questions about the planet's density, its interactions with the solar wind, its thermal characteristics, and others.

Lewis Awards Grant to Minority University

In a joint government/university/industry effort, Lewis Research Center in Cleveland awarded a $150,980 grant to Atlanta University, Ga. Industry support for the project is from Lockheed-Georgia Co., Marietta, Ga.

Under the year-long project, Atlanta University, an institution with predominantly Black enrollment, will conduct research in processible high-strength fibrous polymers, a low cost silicon for possible use in solar cells and complex iron molecules for potential use in development of a chemical storage system. As a part of the program, the university plans to establish a campus computerized laboratory in support of the effort.

Lockheed-Georgia is contributing $25,000 in technical support and specialists. NASA Lewis will monitor research being carried out by the university.

This jointly funded program is part of an initiative to increase the participation of historically Black colleges in federal programs and the National Commission on Research recommendation that the federal government provide incentives to initiate closer research ties between industry and universities.

Nick Panagakos, Space Science PAO, Dies

Nicholas W. Panagakos, NASA's Public Affairs Officer for Space Science, died on December 28, in Portland, Maine. He was 55. Nick was visiting family for the holidays when he suffered a massive heart attack about 9 p.m. He was dead on arrival at Portland Hospital.

Nick was responsible for all NASA public affairs activities which concerned America's space science programs. He received the NASA Exceptional Service Medal in 1979 for his work during the Viking explorations of Mars and received the NASA Exceptional Performance Award in May 1980, for his efforts to bring to the public the activities associated with the Voyager encounter with Jupiter and the Pioneer probes to Venus.

Nick joined NASA in September 1962 and worked for eight years as the principal information officer for the Goddard Institute for Space Studies, New York. He was appointed Public Affairs Officer for Space Science in 1971.

Prior to working for NASA, Nick was science editor for the *Boston Herald* and before that was a documentary science writer for Metro-Goldwyn-Mayer in New York.

During the 1968 Presidential campaign, Nick served as a speech writer for Senator Edmund S. Muskie, the Democratic vice presidential candidate. He was employed by the Gannett Newspapers from 1953 to 1960.

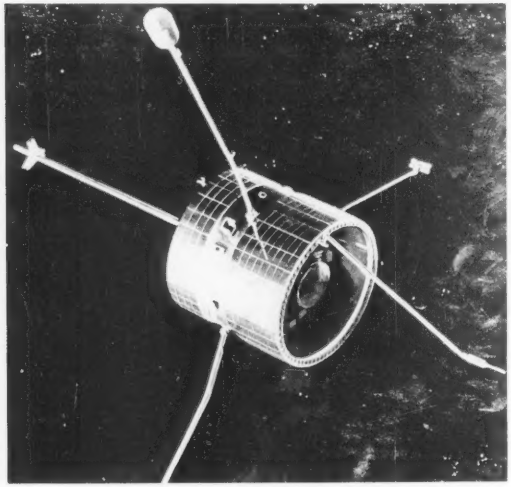
A graduate of Harvard College, Nick studied for his master's degree at Boston University and was a 1960-61 Sloan-Rockfeller Fellow in Advanced Science Writing at Columbia University's Graduate School of Journalism.

Nick was a resident of Glenn Dale, Md. He was born in Portland, Maine, Nov. 21, 1925. He is survided by his sister, Rita Doukas, and four brothers, Krist, Petros, Peter and Charles, all of Portland.

Pioneer 6 Still Turning Out Data After 15 Years

December marked 15 years that NASA's Pioneer 6 interplanetary spacecraft has circled the Sun and returned good data—the longest operating life ever attained by an interplanetary spacecraft. The original Pioneer 6 specifications called for a working life of six months.

Pioneer 6 made the first detailed measurements of the interplanetary medium, some spanning a half



Artist's rendition of the Pioneer spacecraft in orbit.

billion miles. The workhorse spacecraft has measured the Sun's corona, returned data on solar storms and measured a comet's tail. It has made discoveries about the Sun itself; and about the solar wind, solar cosmic rays and the solar magnetic field, all three of which extend far beyond the orbit of Jupiter.

Pioneer 6's three sister spacecraft, Pioneers 7, 8 and 9, also are years beyond their six-month design lives. Together the four Pioneers make up a network of solar weather stations which circle the Sun, usually in locations millions of miles apart. All of the current Pioneers (Pioneer 6 through 11 and the Pioneer Venus Orbiter) are still operating, and were designed as rugged, relatively simple, low-cost spacecraft.

Pioneer 6 was built by TRW Systems, and the Pioneers are managed by NASA's Ames Research Center, Mountain View, Calif. Five of the six scientific instruments, and all other systems, aboard Pioneer 6 continue to work well.

Since launch in December 1965, the 64-kilogram Pioneer has, like a tiny planet, circled the Sun 17½ times, covering just over 9 billion miles. During its 15-year life, the spin-stabilized, solar-powered craft radioed back measurements 24-hours-a-day from all around the Sun. Because newer missions have required tracking time on the "big dish" antennas of NASA's Deep Space Network, Pioneer 6 has often been pushed aside. The spacecraft has sent about four billion data bits to Earth. Data is transmitted to Pioneer experiments, to other space scientists and to the "solar weather forecasters" of the National Oceanic and Atmospheric Administration's Solar Disturbance Forecast Center at Boulder, Colo.

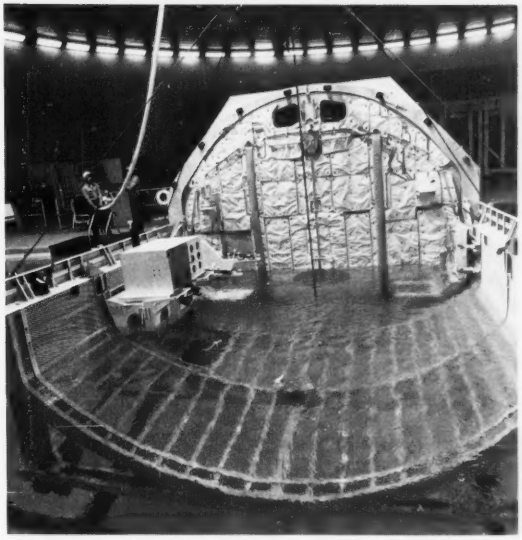
At Boulder, measurements by the four Pioneers, whose positions on various sides of the Sun change constantly, are used to predict solar storms for about 1,000 primary users. These include the Federal Aviation Administration, commercial airlines, power companies, communication (radio) companies, military organizations and organizations doing surveying, navigation and electronic prospecting.

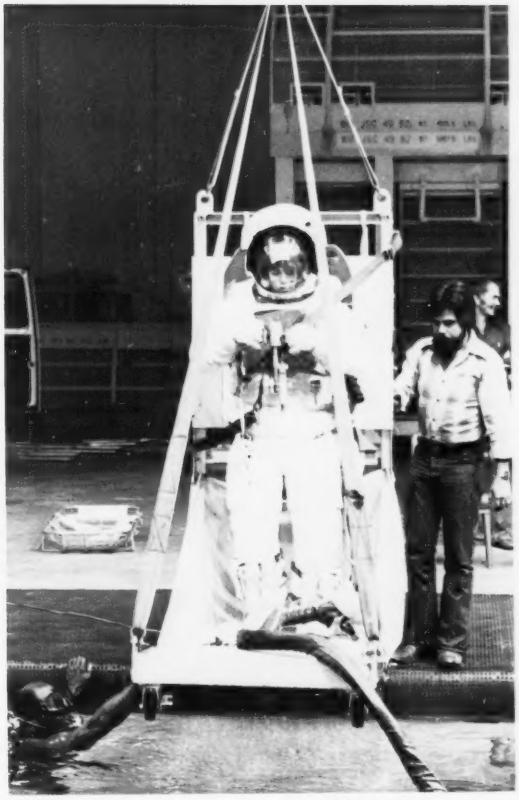
In August of 1980, it was found that Pioneer 6 had "turned itself off due to a momentary power shortage" and was "lost." Ames controllers were able to command it back on again by radio signal from Earth, and Pioneer instruments resumed their observations.

The sides of Pioneer 6 are covered with solar cells and divided by a narrow circular band with openings from which four experiments and four orientation-and-timing Sun sensors look out during the instrument's full-circle scans with spacecraft rotation.

The longevity of Pioneer 6 allowed time for it to get behind the Sun and see the corona. It also allowed important studies of the same solar wind stream by two spacecraft, one millions of miles "down solar wind" from the other. In August 1972, during a cataclysmic solar storm, when three huge solar flares were superimposed on each other, Pioneer 6 measured effects of the solar shock wave on its side of the Sun.

In September 1975, Pioneer teamed up with the U.S.-German Helios satellite, which was 6 million miles inside the orbit of Mercury, closer to the Sun than any spacecraft had yet gone. This helped complete the picture with measurements very close to the Sun, tied to a look at the same solar particles and fields near the Earth. These measurements are now being matched with the earlier looks at solar phenomena seen first by Pioneer 6 and later by Pioneers 10 and 11 far out near Jupiter.





New Weightless Training Facility—In November, the new Weightless Environment Test Facility (WET-F) began operation in Building 29 of the Johnson Space Center. WET-F measures 33 feet wide, 78 feet long, and 25 feet deep—large enough to hold a full-size mockup of the Shuttle orbiter payload bay. Six submersible cameras follow training operations, two operated by divers and four mounted underwater with pan, tilt, and zoom manipulated from a console at the pool's edge. Shown are technicians lowering the payload bay mockup and astronaut Anna Fisher conducting the first exercise in WET-F.

Scientists Develop New Storm Study

A team of NASA scientists and technicians at Goddard Space Flight Center have pioneered a stereo-imaging technique for the study of hurricanes. The technique uses photos of the top of the same hurricane taken by two different Geostationary Operational Environmental Satellite (GOES) spacecraft, GOES East and GOES West.

Both of these satellites are geosynchronous, that is, their orbital speed matches the Earth's spin rate and hence they hover over one spot on the Earth. Both are stationed along the equator, GOES East at 75 degrees West longitude and GOES West at 135 degrees West.

A team headed by Dr. A. F. "Fritz" Hasler and E. B. Rodgers used cloud cover photos taken simultaneously by these satellites of Hurricane Frederic on Sept. 12, 1979, over the Gulf of Mexico. The images were then remapped in a computer and combined for stereo display and analysis on Goddard's Atmospheric and Oceanographic Information Processing System.

The photography from both spacecraft, taken during a period of several hours, was combined in a time-lapse sequence, representing steps of as little as 7½ minutes, to produce significant improvements over previously used techniques. For example, changes can be seen in the storm's Central Dense Overcast or the large dense cloud over the storm as seen from space.

Estimates can also be made of the storm's intensity from the stereo height observations of this overcast, when combined with infrared measurements of the cloud top temperature taken by other instruments on these spacecraft, together with a conceptual model.

The new technique was reported by Dr. Hasler at the American Meteorological Society's 13th Technical Conference on Hurricanes and Tropical Meteorology meeting in Miami in December.

The technique—which takes only a few hours—represents a significant improvement over the previous practice of shooting and analyzing aircraft photos which took several months. Its developers believe it can be readily transferred to operational weather forecasters for routine use.

Radio Astronomy Adapted for Earth Studies

Scientists at the Goddard Space Flight Center have developed a high precision radio astronomy system, and are using it in studies of the movement of the Earth's crust. Two or more antennas are used to observe fixed extragalactic sources, usually quasars, in a technique called Very Long Baseline Interferometry. Applying this principal to Earth crustal studies, the quasar signal's difference in arrival times at the two stations can be used to geometrically determine the distance between the two stations with a high degree of accuracy.

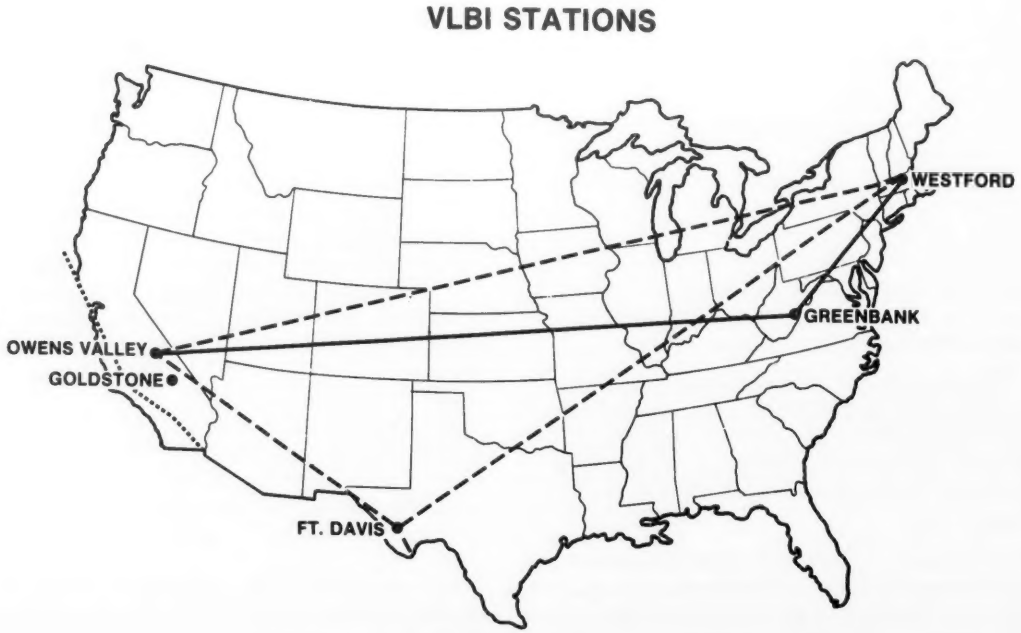
The baseline, or straight-line distance, between stations at Westford, Mass., and Bishop, Calif. has been measured with a precision of 3 centimeters, or better than one part in a hundred million.

The Very Long Baseline Interferometry technique is one of several methods NASA is developing with other federal agencies to study the movement and deformation of the Earth's crust. These studies, for example, are expected to contribute to an understanding of why and how earthquakes occur.

Formation with other countries of a global station network and some of its work were reported by NASA geophysicist Dr. Chopo Ma at the American Geophysical Union meeting in San Francisco, in December.

Dr. Ma reported that a number of fundamental questions in geophysics are now being investigated by NASA using space techniques. What is the nature and magnitude of tectonic plate motion? What is the behavior within a plate, especially continental plates, such as North America? What is the relationship between fluctuations in the Earth's rotation and large earthquakes?

The Very Long Baseline Interferometry technique has been developed for ultra-precision geodesy by a Crustal Dynamics Project team of scientists from the Goddard Space Flight Center; Haystack Observatory, Westford, Mass.; the Massachusetts Institute of



Very Long Baseline Interferometry (VLBI) station network.

Technology, Cambridge; and the Jet Propulsion Laboratory, Pasadena, Calif.

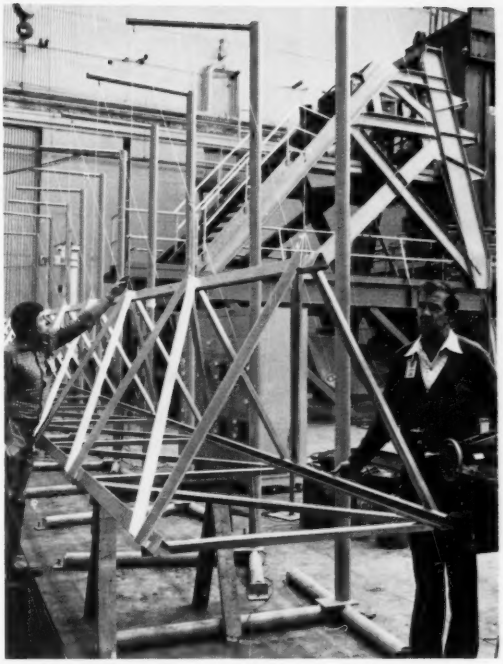
The Very Long Baseline Interferometry method is now using a highly sensitive, accurately calibrated, automated system (Mark III) designed for making geodetic measurements with fixed or mobile radio astronomy antennas of various sizes, ranging from 4 meters to 64 meters in diameter. The project has conducted geodetic observations with the Mark III systems at fixed radio astronomy stations in California and Massachusetts, mentioned earlier, and at Green Bank, W.Va.; Ft. Davis, Texas; Onsala, Sweden; Bonn, Germany; and Chilbolton, England. The Crustal Dynamics Project group at the Jet Propulsion Laboratory is implementing the Mark III system into a mobile station for measurements of crustal movements in the western United States.

Very Long Baseline Interferometry can measure the rotation of the Earth and polar motion with a current precision of better than 10 cm. Such precise measurements may shed light on the relationship between changes in the Earth's orientation and movements in the Earth associated with large earthquakes. Such movements may occur before an earthquake but so slowly and over so large a region as to be undetectable by conventional means.

Using Very Long Baseline Interferometry stations, the Crustal Dynamics Project has made measurements on the longer baselines to measure continental drift and on the shorter ones to monitor regional activity.

Measurements from Massachusetts to West Virginia and California since 1976 indicate overall continental stability; i.e., no more change than 2 cm per year. The baselines to Texas, first measured in April 1980, will allow more detailed examination of the eastern and western sections of North America. Many measurements have been made in California since that is an area of known regional activity.

In cooperation with the National Geodetic Survey of the National Oceanic and Atmospheric Administration and several international organizations, Very Long Baseline Interferometry measurements were made by NASA in July, September and October 1980, as part of the Monitoring Earth Rotation and Intercomparison of Techniques program. These data, equal in amount to what was acquired in two previous years, are now being analyzed and are to be published next spring. They will provide unprecedented opportunities to compare the details of the Earth's orientation as determined by other techniques and to check the United States-to-Europe baselines for plate motion and stability.



Model Testing of Beams—Danny Coleman (left) of NASA's Marshall Space Flight Center's Test Lab Dynamic Test Branch, and Garland Johnston, Chief of the Branch, prepare a beam made by the Center's automatic beam builder for model testing. The tests are designed to determine the dynamic response of the beam at different locations along the length of the beam as it is vibrated at different frequencies. After these tests are completed, they will be repeated with the beam suspended vertically. Results will be used to establish norms and predict possible problem areas.

Launch Agreement with Indonesia

Dr. Stanley I. Weiss, NASA Associate Administrator for Space Transportation Operations, and Drs. Suryadi, Director General of Posts and Telecommunications for the Republic of Indonesia, signed an agreement in Jakarta in December calling for the launch by NASA of two Indonesian communications satellites.

The two satellites, Palapa B-1 and B-2, operating in geosynchronous orbit, will provide voice, video, telephone and high-speed data services to Indonesia and other member states of the Association of Southeast Asian Nations—the Philippines, Thailand, Malaysia and Singapore.

Under terms of the agreement, the two satellites will be launched by the Space Shuttle or, at

Dr. Stanley I. Weiss (left), NASA Associate Administrator for Space Transportation Operations, and Drs Suryadi, Director General of Posts and Telecommunications for the Republic of Indonesia, sign agreement in Jakarta for the launch by NASA of two Indonesian geosynchronous communications satellites.

Indonesia's option, by Delta expendable launch vehicles. The present schedule calls for Palapa B-1 to be launched from the Space Shuttle in January 1984, or by a Delta in January 1983. Palapa B-2 will be launched by the Shuttle in March 1984 or by a Delta backup in January 1984. Two earlier versions of the Palapa satellites were launched by NASA in 1976 and 1977.

The agreement calls for Indonesia to be responsible for satellite checkout and integration of the Spinning Solid Upper Stage which will boost the satellites into elliptical transfer orbit from where they will be maneuvered into their geosynchronous operating orbits. NASA will provide all other launch-related services through the Kennedy Space Center. Earlier this year NASA signed launch services agreements with Intelsat, Satellite Business Systems and the Government of India.

The operational Space Shuttle and expendable launch vehicle programs are managed by NASA's Office of Space Transportation Operations.

Earth Radiation Budget Satellite

Ball Aerospace Systems, Division of Ball Corp., Boulder, Colo. has been selected for negotiation of a contract to provide the Earth Radiation Budget Satellite as well as its mission operations support. The contractor's proposed estimated cost of this cost-plus-award fee contract is approximately $21 million. The satellite is to be integrated, tested and delivered ready for launch on the Shuttle by April 1984.

The satellite, with its Earth Radiation Budget Experiment instruments, will become part of a three-spacecraft system—with NOAA-F and G—to use scanning and non-scanning radiometers to measure the amount of solar radiation received and given up by different regions of the Earth.

The Earth absorbs more solar energy in some regions and emits more thermal energy in others. This heating differential sets wind and ocean currents in motion to transfer heat from heated to cooled areas. Hence, the Earth's radiation budget, as a driving force for weather, is one of the factors on which comprehensive data is needed for better weather and climate predictions.

Although there have been Earth radiation budget instruments in NASA's experimental Nimbus 6 and

7 spacecraft, this will be the first time this factor can be measured on a global basis over a 24-hour day.

The satellite will include systems for power, command and data handling, attitude control (three-axis stabilized), orbit adjust, as well as a thermal control. The spacecraft will communicate via the Tracking Data and Relay Satellite System. After launch by the Space Shuttle, the satellite will boost itself into a 600-kilometer circular orbit, inclined 46 degrees to the equator.

This mission is a part of the climate research program of NASA's Office of Space and Terrestrial Applications. It will be managed by NASA's Goddard Space Flight Center. Ball Brothers will design, develop, fabricate and integrate the government-furnished instruments with the satellite bus, test the satellite and provide its prelaunch and postlaunch support.

NASA Selects Hughes for Jupiter Mission

The Space and Communications Group of Hughes Aircraft Co., has been chosen for negotiation of an estimated $40 million contract for the Galileo probe carrier spacecraft. The work on the probe carrier will be performed at Hughes Space and Communications Group facilities in El Segundo, Calif.

The carrier will transport the Galileo probe to Jupiter, where the probe will separate and enter Jupiter's atmosphere. It will measure the atmosphere for an hour down to a level where atmosphere pressure is 10 times Earth's surface pressure.

The Galileo probe carrier and probe are to be launched by NASA's Space Shuttle in March 1984 and will reach the planet 1,200 days later, in July 1987.

The probe will separate from the carrier 100 days before planet arrival and will enter Jupiter's thick atmosphere at a speed of 160,000 kilometers per hour, slowing in a few seconds to a few hundred miles per hour. At this point, a parachute will open and the probe will slowly descend.

Jupiter's atmosphere is believed to be made of the original material from which the stars formed, and scientists are greatly interested in this. A vertical profile of atmosphere composition and movements will allow understanding of Jupiter's weather, currently a mystery, and may provide insights into Earth weather mechanisms.

The carrier will receive scientific data from the probe during its entry and descent into Jupiter's atmosphere, and will transmit the data back to receiving stations on Earth. Communications with Earth will be maintained throughout the mission, with probe data returned both in real time and with later playback from tape recorders.

The carrier will be nuclear powered by two radioisotope thermoelectric generator units because solar energy is too weak for power as far out as Jupiter.

Probe and probe carrier development is by NASA's Ames Research Center, Mountain View, Calif.

Lee Named Marshall Deputy

Thomas J. (Jack) Lee has been appointed Deputy Director of the Marshall Space Flight Center, Huntsville, Ala. Dr. William R. Lucas, Director, made this and several other key personnel assignments, all effective December 1.

For the past six years Lee has been the manager of the Marshall Center's Spacelab Program Office, the organization that heads NASA's work with the European Space Agency in the development of the Spacelab carrier, a prime payload of the Space Shuttle.

Lee has been a member of the Marshall Center and its predecessor organization since 1958. Born in Wedowee, Ala., he attended Woodlawn High School and was graduated from the University of Alabama with a degree in aeronautical engineering in 1958. He has held progressively responsible positions in the management of several principal projects and in 1973 received the NASA Medal of Exceptional Service for his outstanding leadership, management and technical contributions to the Saturn launch vehicle program.

NASA Accepts Spacelab Model

A milestone in European-American space cooperation was marked in late November, when the Spacelab engineering model was accepted by NASA in a rollout ceremony in Bremen, West Germany.

The engineering model is a prototype of the Spacelab flight unit but is not intended for flight on board the Space Shuttle. It will be used by NASA to prepare for processing the flight unit, including

verification of the interface of the space laboratory with ground equipment at the Kennedy Space Center launch site.

Representing NASA at the turnover at the VFW-ERNO plant were Douglas R. Lord, Director of the Spacelab Program at NASA Headquarters; James R. Morrison, NASA European Representative; and T. J. Lee, Manager of the Spacelab Program Office at NASA's Marshall Space Flight Center and new Deputy Director. ERNO is prime contractor to the European Space Agency (ESA) for Spacelab. Marshall is the lead NASA center for Spacelab development.

Also present were the five payload specialist candidates for the first Spacelab mission, Drs. Michael Lampton and Byron Lichtenberg of the United States and Drs. Ulf Merbold, Wubbo Ockels and Claude Nicollier of Europe, plus the two mission specialists, astronauts Owen Garriott and Robert Parker. All are in Europe undergoing mission training.

The delivery of the engineering model constitutes the first major transfer of Spacelab hardware to NASA under the ESA-NASA memorandum of understanding signed in 1973. It will be followed by the delivery of the first Spacelab flight unit in 1981. NASA has ordered a second flight unit for delivery in 1982-83.

Douglas R. Lord, NASA Director of the Spacelab Program, speaks at ceremony at the WFW-ENRO plant, Breman, West Germany, during acceptance of the European Space Agency's Spacelab Engineering Model. Following the ceremony the unit was air lifted to the Kennedy Space Center, Fla., where it is being used for ground checkout and crew training. The first Spacelab flight unit is scheduled for delivery in mid-1981.

The first mission, scheduled for June 1983, on the tenth Space Shuttle flight, will be a joint ESA-NASA effort and will carry scientific experiments presently under development in Europe and the United States. The second flight is scheduled for later in 1983.

Shuttle Assurance Tests

Space Shuttle main engines, containing spalled (slightly pitted or flaked bearings) and cracked turbine blades were test fired to demonstrate that the liquid fuel engines can tolerate less than perfect conditions and still successfully perform one or more Shuttle missions.

The test firings began the week of December 15 at NASA's National Space Technology Laboratories, Bay St. Louis, Miss., and at the Rocketdyne Div. of Rockwell International, Canoga Park, Calif.

The turbine blades and bearings are parts of an engine's high pressure oxidizer turbopump. Out of more than 153 tests totaling over 34,000 seconds of operation with 23 high pressure pumps, there have been five instances of bearing spalling.

This condition, evidenced by surface distress of some bearings, has been detected in post-test inspections. In each case, engine and pump operation was satisfactory.

NASA believes that the spalling may have been a result of less than adequate chilldown of the pump prior to starting the engine. Since improving the chilldown process, several months ago, six pumps have been run in engines for a total of over 25 tests and 7,500 seconds of operation. In these, there have been zero instances of spalling. Even though the flight engines on the Space Shuttle Columbia do not have spalled bearings, NASA wants the added assurance that an engine, with spalled bearings at the start of a mission cycle, will perform successfully.

While some cracked turbine blades have been found after engine runs, in over 98,000 seconds of testing no failures or engine malfunctions have resulted because of these cracked blades. As with the spalled bearings, engine tests with cracked blades are being conducted for the purpose of obtaining the added assurance such demonstrations provide.

The test firings are being conducted under the direction of NASA's Marshall Space Flight Center, Huntsville, Ala.

Early Bird at Ames—The bright-eyed lady emerging from ARC's Flight Simulator for Advanced Aircraft is Neta Snook Southern, 84, one of the first women pilots. She was Amelia Earhart's flight instructor about 1920. In marked contrast with what she saw at Ames, Mrs. Southern said her old plane was made of wood and cloth, had no gas gauge, and the instrument panel consisted of an altimeter and a dollar watch hanging from a hook.

Did You Know?

The Sounding Rocket Program observed its 10th anniversary as a fixture at Wallops Flight Center; program responsibility was transferred to the Eastern Shore facility in November 1970 from Goddard Space Flight Center and program management for sounding rockets is shared by the two centers. Sounding Rocket launch vehicles make over 60 flights a year from Wallops and they carry research payloads to make measurements at altitudes ranging from 20 miles to over a thousand miles above the Earth's surface. The sounding rocket allows space scientists to conduct investigations at a specified time and place; thus, the operations are conducted on a worldwide basis.

Jet Propulsion Laboratory solar energy specialists have begun work on a project which could produce as much electrical power as one nuclear reactor—from a salt water pond. The technology, developed in Israel, will be applied to the Salton Sea Solar Pond Project, now in the study phase at JPL. If completed, the program is expected to provide 500 megawatts of electricity from a single plant. That's enough clean, inexpensive and renewable energy to service 500,000 homes in California's Imperial Valley by the late 1980s. Unlike some solar collectors, ponds heavy with salt can operate year round, on cloudy and sunny days, and even at night.

John F. Kennedy Space Center, Fla., in cooperation with the United States Postal Service, is offering a cancellation service to interested philatelists for the space flight programs at Kennedy.

Philatelists who wish to avail themselves of this service may do so by following the procedures outlined as follows:

- Specify the event for which you wish this service. There is a limit of five covers per customer per event.
- All covers must be self-addressed and bear at least first class postage or proper postage for international mail placed three quarters of an inch down from the right top of the cover. Envelopes should contain a filler not to exceed the thickness of a postal

or computer card to assure a clear cancellation.

- All inquiries must be accompanied by a stamped, self-addressed envelope.
- Requests for service must be received at least five days prior to an event, but no earlier than 30 days before. Requests should be sent to: Chief, Mail and Distribution Services, SI-SRV-1M, Kennedy Space Center, FL 32899.

Services not provided are:

- Requests for personally autographed covers, or for carrying covers on board during flight or preflight activities.
- Cachet service (rubber stamp) for such major events as the first launch of the Space Shuttle.
- Hand-back service.

Idea Clearinghouse this month suggests an increase in efficiency through automated instrument calibrations used to validate measurements from instruments such as amplifiers, multimeters, pyrometers and voltage-controlled oscillators. Langley Research Center projects require over 15,000 such instrument calibrations each year. A number of modular systems using the programmable calculator as a system controller were developed which automatically acquire data and control the calibration of electrical and non-electrical instruments.

A calculator programmed in BASIC language directs the technician through each step of the calibration procedure by displaying a series of questions and instructions. When completed the data is automatically acquired, processed, analyzed and printed into a format which serves as the final calibration data sheet. Benefits from this automation include improved turnaround time, uniformity of procedures and data analysis, as well as reduction in cost. If you would like to learn more about this idea contact Langley's Frederick A. Kern, Head, Optical and Pressure Measuring Section, FTS 928-3234, or Mail Stop 236.

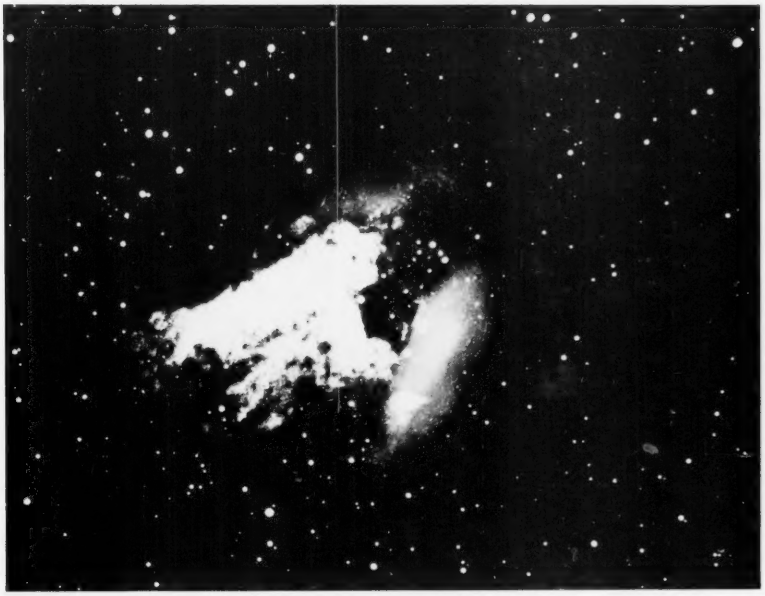
Patents for Inventions from NASA Research

The office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) and Employer	Title	Patent No.	Installation
Samuel Berkman, Harold E. Temple, ... RCA Corp., Princeton, N.J.	Apparatus for use in the production of ribbon- ..... shaped crystals from a silicon melt	4,242,553	NRO/JPL
Robert W. Rosser, NASA/ARC; ..... Roger A. Korus, San Jose State Univ., San Jose, Calif.	Process for the preparation of fluorine containing .... crosslinked elastomeric polytriazine and product so produced	4,242,498	ARC
Jack E. Cornett, Andrew A. Saunders, ... Ira E. Marvin, General Electric Co., Cincinnati, Ohio.	Integrated control system for a gas turbine engine ..	4,242,864	LeRC
James B. Breckinridge, Caltech/JPL, ... Pasadena.	Interferometer	4,243,323	NRO/JPL
Jovan Moacanin, Amitava Gupta, ... Su-Don Hong, Caltech/JPL, Pasadena.	Double-beam optical method and apparatus for .... measuring thermal diffusivity and other molecular dynamic processes in utilizing the transient thermal lens effect	4,243,327	NRO/JPL
Shmuel J. Merhav, National Research .... Council, Washington, D.C.	Autonomous navigation system	4,244,215	ARC
Tito T. Serafina, Peter DeLuigs, ... NASA/Lewis.	Composition and method for making polyimide .... resin-reinforced fabric	4,244,853	LeRC
Tito T. Serafini, Peter DeLuigs, ... Raymond D. Vannucci, NASA/LeRC.	Curing agent for polyepoxides and epoxy resins .... and composites cured therewith	4,244,857	LeRC
Col. William T. McLyman, Caltech/JPL, .. Pasadena.	Elimination of current spikes in buck power ..... converters	4,245,288	NRO/JPL
Robert W. Rosser, NASA/ARC; ..... Ibrahim M. Shalhoub, Hanoi Kwong, San Jose University, Calif.	1, 2, 4 -oxadiazole elastomers	4,245,085	ARC
John Paulkovich, Ernesto Rodriguez, ... NASA/GSFC.	Buck/boost regulator	4,245,285	GSFC

Launches for 1981

Name	Launch Date	Vehicle	Range	Mission Remarks
COMSTAR-D	February 19	Atlas Centaur	ESMC	Comsat General Corp. communications. Reimbursable.
Intelsat V-B	March	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
GOES-E	March	Delta	ESMC	NOAA weather. Reimbursable.
Navy 20 (NOVA 1)	April	Scout	WSMC	DOD transit. Reimbursable.
SBS-B	April	Delta	ESMC	SBS communications. Reimbursable.
NOAA-C	May	Atlas-F	WSMC	NOAA weather. Reimbursable.
Intelsat V-C	June	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
RCA-D	June	Delta	ESMC	RCA communications. Reimbursable.
FLTSATCOM-E	June	Atlas Centaur	ESMC	DOD communications. Reimbursable.
Dynamic Explorer	July	Delta	ESMC	NASA scientific.
Navy 21 (NOVA 2)	September	Scout	WSMC	DOD transit. Reimbursable.
Intelsat V-D	September	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
Solar Mesospheric Explorer	September	Delta	WSMC	NASA scientific.
RCA-C1	October	Delta	ESMC	RCA communications. Reimbursable.
NOAA-D	November	Atlas-F	WSMC	NOAA weather. Reimbursable.
Intelsat V-E	December	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.



Map of Swan Nebula (enhanced) —In this updated version of an image released last July, the infrared region is superimposed on a black-and-white photograph provided by the University of California. Scientists created this image of the Swan Nebula (also known as M17) using data obtained from the Ames Research Center to show how it would appear if viewed through a large telescope sensitive to infrared.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Emergency Lighting System

Shown in operation below left at the Washington National Airport is Stem-Lite, an emergency lighting system widely used by fire, police, ambulance, and other emergency service departments. Stem-Lite, composed of four floodlights which provide 2,000 watts of daytime-equivalent visibility and a high-intensity flashing beacon, can be elevated 10 feet above the roof of an emergency vehicle by means of an extendible mast. The higher elevation expands the effective radius of the floodlights and increases the beacons visibility to several miles.

When not in use, the lights can be retracted into the compact rooftop housing shown in the photo at lower right. In addition to the lights, the Stem-Lite system includes a generator which also can serve to power such emergency equipment as pumps and drills, and a dashboard-mounted control panel for switching the lights and extending and retracting the mast.

The spinoff element of Stem-Lite is the mast, originally developed by SPAR Aerospace of Canada to allow extension and retraction of antennas on NASA spacecraft, including Mercury, Gemini, Apollo, and a number of unmanned satellites.

For the benefit of all . . .

NASA
National Aeronautics and Space Administration

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